THE TELEGRAPHIC JOURNAL.
Vol. II.—No. 35.

ON THE

DETERMINATION OF VERITABLE SIMPLE BODIES BY THE ACTION OF BATTERY CURRENTS IN THE VOLTAMETER.

By M. E. MARTIN.

A study of the voltameter, comprising the scrutiny of bodies which co-operate in its action to decompose water, appeared necessary in the first place, in consideration of the admitted theories which seemed to me contestible on several essential points.

Physicists admit that the two battery currents carried by the wires into the voltameter follow a closed circuit, of which the interposed liquid forms the complement. They also admit that these currents decompose water in its passage, like physical forces, and that positive electricity conveys hydrogen gas to the negative pole, whilst negative electricity bears away oxygen gas to the positive pole. They consider that everything which favours the passage of the current facilitates the decomposition of water; that the quantity of gas disengaged, very feeble when the water is pure, increases with the quantity of acid or salt dissolved in it; these additions having the effect of increasing its conductibility.

From my researches I found that the decomposition of water did not take place under the conditions enunciated by the above admitted theory, and I believe I shall be able to show—(1) that the two electricities are not forces, but imponderable bodies endowed with powerful and different chemical affinities, and that they do not act as physical forces, but that they effect upon the elements of the water a double chemical action, which transforms them into gas; (2) that there is an error as regards the constitution of water, which does not include, as is pretended, two condensed gases that have only to be separated to reproduce them, but that the single simple bodies, H and O, are its elements; (3) that the two gases whose combination produces water are *compound* bodies, formed by the chemical union of positive electricity to the simple oxygen body, and negative electricity to simple hydrogen,—the combination of these gases giving two binary bodies, water and caloric; (4) that the battery currents do not traverse the acidulated voltameter liquids, and do not effect the transport of the elements, but that the two electricities simply arrive at the electrodes, and there unite with the elements of the water in transforming them into hydrogen gas at the negative pole and oxygen gas at the positive pole.

The two electricities playing the principal part in these decompositions, I thought to be able to establish the materiality of these two simple bodies, and also of the two compound imponderable bodies which arise from their union, and which are light and heat. Our reason tells us that the material universe is not formed of heavy bodies alone, but also of imponderable elements which manifest themselves to our senses by sensations, by transformations which they effect, and by meteorological phenomena to which they give place. I add thereto the scientific demonstration that all bodies appreciable—ponderable or not—by physical and chemical properties are material.

All physicists and chemists know that matter has two qualities; that it is by the impressions these qualities make on our senses we discover its existence. We must therefore take for material bodies those substances possessed of physical and chemical properties.

Now it is likewise known that light has physical and chemical properties. It is also verified that caloric obeys the physical laws which regulate elastic fluids, and that it combines in definite proportions with ponderable bodies when it transforms them into liquids and vapours.

The physical properties of the two electricities are manifest; they course, penetrate, and shatter, obstacles. Indeed they possess powerful and different chemical affinities, which manifest themselves at a distance by producing electric attractions. When in contact they enter into chemical combination one with the other in generating caloric and light, as may be seen in the sparks of small charges, and especially in the reunion of the two currents of a battery of 100 elements. The two electricities form, besides, chemical combinations with simple bodies, and, thus formed, these are the compounds which—since Lavoisier—have been taken for simple bodies. I have, then, the right to consider the two electricities as simple material bodies, and heat and light the combinations which these two simple imponderable bodies form in combining one with the other as compound material bodies,

In considering the two electricities as distinct simple bodies, I have given them names; I call the so-named negative electricity, *electrile*, with the symbol El—; positive electricity, *etherile*, with Et for a symbol. The two combined gases have, then, for formulæ, HEl— for hydrogen gas, and OEt for oxygen gas. Two volumes of the first and one volume of the second are introduced into an eudiometer, and when the electric spark has broken up the neutrality of these bodies combustion is instantaneous: a trace of fire is visible, and the gases no longer exist. In their place exists some steam, which condenses into water, and represents exactly the weight of the two gases,—*i.e.*, it contains the two elements H and O reduced to some millionths of the volumes of the original gases, whilst the union of the imponderable bodies El— Et has produced a considerable amount of definite caloric. This caloric, physicists say, existed in the gases. That is an error; the electricity Et constituted part of the oxygen gas, El— part of the hydrogen gas; and when these two gases enter into combination a double decomposition takes place, which can be represented by the equation—

$$\mathrm{HEl}- + \mathrm{OEt} = \mathrm{HO} + \mathrm{Et\,El}-,$$

water and caloric. The two gases do not contain caloric, but the elements of it only.

I have given, in a previous memoir, the theory of the gas battery, in which the two gases HEl—, OEt, give the compound HO, whilst the two elements El—, Et, set at liberty, are collected on the metallic conductors in the form of currents.

So with the zinc, ZnEl—, and sulphuric acid battery; in it the ponderable bodies, by uniting, always surrender the two simple imponderable bodies which are collected upon the conductor. In ordinary combustion, the two bodies El— Et, not being collected, unite to form heat.

The water, HO, when submitted to the action of the two currents in the voltameter, generates the two gases HEl—, OEt, by reason of the union which takes place on the platinum electrodes between these four elements, consequent on their affinities. This is shown if we take for conductor at the positive pole a copper wire, for if any oxygen gas arrives at this wire it will be released just as with the platinum, whilst with the simple oxygen body some of the wire is transformed into an oxide, and no gas appears. This is said to belong to the nascent condition of oxygen; precisely so, but the *nascent* condition is the *simple* condition.

It may be said that the necessity of adding to the pure water an acid, or a salt, to increase the conductivity, proves that the currents need to pass. I have a singular objection to make to this means of conductivity. It is, that the addition of an acid or a salt favours the decomposition of the water, by destroying its conductibility instead of augmenting it, and by favouring the accumulation of the two electricities upon the electrodes where the formation of the gases takes place. Electricities, by reason of their powerful affinities, seize upon each one of the elements of the binary compound, oxygen uniting to the positive electricity, hydrogen to the negative electricity, and producing perfect gases.

If pure water is decomposed with difficulty, it is on account of its conductivity. It charges itself at the two poles, and produces twenty times more heat than with acidulated water: this considerable production of heat is evidently due to the meeting of the two electricities, accomplished by the medium of the water's molecules. Experiment likewise proves that pure water contained in a tube conducts electricity very well, whereas sulphuric acid and saline solutions do not conduct it.

I conclude, from these facts, that to separate the elements of compound soluble binaries, and divers salts, into the condition of simple bodies, it is sufficient to submit them to the action of the two battery currents in a voltameter. Those which combine with the positive electricity, whose affinity is energetic, are oxygen, azote, fluor, chlorine, bromine, and iodine, to which must be added the simple imponderable etherile, to constitute the *oxygen genus.* Those which go to the negative pole to combine with the electrile are more numerous, and constitute the *basic* genus. They comprise the right simple basic metalloids—hydrogen, carbon, bromine, sulphur, selenium, phosphorus, arsenic, silica, and all the metals.

THE report of the Eastern Telegraph Company (Limited) to the meeting held yesterday shows that the revenue for the six months ended March 31 amounted to £202,863, from which, after deducting ordinary and special expenditure, &c., there remains an available balance (including the balance from the preceding half-year) of £164,192. A dividend of 4s. per share is recommended, making, with the three previous payments, a total for the year at the rate of 6 per cent, and £38,993 has been carried to the reserve fund, making that fund £121,838.

BARCELONA-MARSEILLES CABLE.—Number of messages (of 20 words) passing over the line for the month ending—June 30, 1874, 5461 (thirty days); May, 5476 (thirty-one days); April, 4065 (thirty days).

IMPORTANCE OF A RATIONAL GROUPING OF BATTERY ELEMENTS IN ELECTRICAL APPLICATIONS.

By M. TH. DU MONCEL.

WE know that Ohm, to establish the better conditions of a battery with regard to a given circuit r, imagined the surface of a battery of n R resistance to be divided into n equal parts, so as to constitute a battery of n small elements in series giving for the strength of the current—

$$\mathrm{I}=\frac{n\mathrm{E}}{n^2\mathrm{R}+r}$$

a formula susceptible of maximum, whose conditions answer to $n^2\mathrm{R}=r$.

This formula not exactly answering to the method of grouping battery elements, I have discovered by the following reasoning a more practical expression.

Let n be the total number of the elements of a battery disposable in whatever manner we please. Call b the number of elements joined up in a group for quantity, and call a the number of these groups; then $a\,b=n$. The quantities a and b may, besides, have any values we wish, from 1 to n, according to the exigencies of the experiment, but on condition, however, that they shall be whole numbers, and that $a\,b=n$. If it cannot be so arranged, one ought to adopt the combination which will furnish for a and b the values that will most approach those exacted by the conditions of the experiment, and at the same time which will most approach to n when a and b are multiplied by one another. In the instance when $a=1$ and $b=n$, all the elements are disposed for quantity, and when $a=n$ and $b=1$ they are placed in single series.

Suppose, now, that we have a group composed of b elements grouped for quantity, the strength of the current, according to the law of Ohm, will be—

$$\mathrm{I}=\frac{\mathrm{E}}{\frac{\mathrm{R}}{b}+r}=\frac{b\mathrm{E}}{\mathrm{R}+br}$$

If now we join up a number of these groups in single series, using all the n elements, then—

$$\mathrm{I}=\frac{a\mathrm{E}}{\frac{a}{b}\mathrm{R}+r}=\frac{ab\,\mathrm{E}}{a\mathrm{R}+br}=\frac{n\mathrm{E}}{a\mathrm{R}+br}$$

Again, this formula, which represents in a general manner the potential of a battery all of whose elements are disposed in series of groups, is susceptible of a maximum, for b being equal to $\frac{n}{a}$, the *denominator* of the last formula becomes—

$$a\mathrm{R}+\frac{nr}{a},$$

and is susceptible of a minimum. In fact, the derivative of this expression, which is—

$$\mathrm{R}-\frac{nr}{a^2},$$

being equal to zero gives $a^2\mathrm{R}=nr$, or—

$$a\mathrm{R}=\frac{n}{a}r,$$

or $a\mathrm{R}=br$, or yet further—

$$\frac{a}{b}\mathrm{R}=r.$$

This shows that the resistance of the circuit r ought to be equal to the interior resistance of the battery—

$$\frac{a}{b}R.$$

Consequently, one may always with a battery composed of several elements obtain for a given exterior circuit, r, a voltaic combination susceptible of furnishing a maximum of electric *potential* without respect to the work produced, nor to Joule's formula.

These maximum conditions once established, it is easy to immediately deduce the values of a and b. From the equation $aR=br$ or—

$$aR=\frac{n}{a}r,$$

we have—

$$a=\sqrt{\frac{nr}{R}} \text{ and } b=\sqrt{\frac{nR}{r}}$$

values, which can be obtained under another form (when the intensity I is given) from the formula—

$$I=\frac{nE}{2R+br}$$

placed under its maximum conditions, and which becomes—

$$I=\frac{nE}{2aR}, \text{ or } I=\frac{nE}{2bR}$$

two equations from which we ascertain that—

$$a=\frac{2Ir}{E} \text{ and } b=\frac{2IR}{E}.$$

We may, besides, readily observe the limits of the exterior circuit's resistance between which there is an advantage in employing such and such a mode of grouping, since these limits for the pairings by b elements joined up for quantity are—

$$\frac{nR}{b(b-1)} \text{ and } \frac{nR}{b(b+1)}.$$

One may now inspect the deductions of these different laws in their application to telegraph purposes. Conceive two telegraphic electro-magnets having each 2200 metres of resistance, and wound with No. 16 wire, applied directly to a Daniell battery of 8 elements in single series. The force obtained for each of them (electro-magnets) will be about 70 grms. at an attractive distance of 1 m.m.; consequently the total force developed in the two will be 140 grms. Now, if instead of two electro-magnets one only is employed, the force will be 200 grms.: 60 grms. will then have been lost by having two electro-magnets, and yet these magnets —being placed directly in connection with the battery—are in the most favourable conditions. At first sight one is led to conjecture some irregularity, or some imperfect connections; there is nothing of the kind, and our calculation will lead to the same result.

Applying the formulæ of Ohm to the two instances just referred to, we find,—1st, that in the case of the single electro-magnet the strength of the current is 4·95, if we represent the electromotive force of the Daniell battery by 5973; 2nd, that in the case of two electro-magnets constituting two equal branches, this strength is represented by—

$$\frac{8\times 5973}{2(8\times 931)+2200}=2{\cdot}79.$$

The powers of these electro-magnets, in these two arrangements, will then lie between them as the squares of the two quantities 4·95 and 2·79. If, now, we admit that the power of the electro-magnet placed in the simple circuit is 200 grms., the power of each of the two others is—

$$\frac{(2{\cdot}79)^2\times 200}{(4{\cdot}95)^2}=64 \text{ grms.}$$

Consequently the simultaneous force of the two electro-magnets will be 128 grms. instead of 200 from one magnet only.

This effect is a consequence of the arrangement of the battery, which is not proportionate to the exterior circuit, since it is nearly four times greater: it is still less proportionate with regard to the circuit constituted by the two branches. The formula—

$$\frac{nE}{2nR+r},$$

which represents, in this instance, the strength of the current in each branch, and which—in the case of a pile arranged in series—gives maximum conditions of—

$$2\frac{a}{b}R=r, \text{ or } \frac{a}{b}R=\frac{r}{2},$$

shows that then the resistance of the battery ought to be half of r, or of the electro-magnet. Therefore the number a of the elements in tension which should compose the battery ought to be—

$$a=\sqrt{\frac{nr}{2R}},$$

from which, according to the experiments already quoted—

$$a=\sqrt{\frac{8\times 2200}{2\times 931}}=3{\cdot}074,$$

and the number of elements "*in quantity*" should b

$$\frac{8}{3074}=2{\cdot}6.$$

But as these are not whole numbers we must adopt that combination which gives to a, b, and n the closest possible values to those calculated for; and we perceive that a battery of 3 elements in series, each of which is also formed of 3 elements "in quantity," will best unit these conditions. With a like battery the power of the one electro-magnet will be 267 grms., and that of each of the two electro-magnets introduced into the two branches will then attain 158 grms., equal together to 316 grms. Thus we gain by having two electro-magnets.

Hence it is evident how important it is to decide precisely the conditions of the experiment, in order that calculations may decide the most suitable arrangements.—*Journal Telegraphique.*

It is stated that the *Faraday* has put in at Portsmouth, New Hampshire, in order to connect the Halifax and Portsmouth section of the deep sea cable with the shores of the United States, the shore end having been sent out on board the *Ambassador*. It was at first contemplated to defer this until the other sections of the cable had been laid, but as the month of August is considered to be the best period of the year for laying the section across the Atlantic, it has been deemed advisable to complete all arrangements connected with the landing of the United States shore end before the return of the cable ship to the coast of Ireland.

MATHEMATICS
FOR
NATURAL SCIENCE STUDENTS.

By T. C. SIMMONS, B.A.

(Continued from p. 228.)

LOGARITHMS.

It is very important for the student now to acquire a knowledge of logarithms, theoretically and in their practical application. It is a department of mathematics which is most interesting and most useful. The inventor of logarithms, Napier, has conferred a benefit upon the mathematical world which cannot be estimated too highly. It has been said, and I think with much truth, that had it not been for logarithms Newton would possibly never have made his great discovery of the law of gravitation. At the outset I would urge the reader not to be alarmed by the formidable word *logarithm.*

I suppose it is already clearly understood what is meant by *powers* of a number,—at any rate, by integral powers. For instance, 10×10, or 100, may be denoted by 10^2; 10×10×10, or 1000, may be denoted by 10^3; a million may, in a similar way, be denoted by 10^6; and in the same way can any number be expressed which consists of the figure 1 followed by any number of 0's. Now if we take a number, such as 43,284 for example, we see that this lies between 10,000 and 100,000, or between 10^4 and 10^5. Thus if there are 5 digits (or *figures*, as they are familiarly called) in the number, it lies between 10^4 and 10^5. So if there are 9 digits the number will lie between 10^8 and 10^9; if there are 12 digits it will lie between 10^{11} and 10^{12}.

Now since $10^3=1000$, 3 is called the logarithm of 1000 to the base 10; so since $10^5=100{,}000$, we call 5 the logarithm of 100,000 to the base 10. The reader will see from this that if any number be a power of 10, the index (or the small figure placed above) which expresses that power is called the logarithm of the number.

But what becomes of a number such as 43,284? We saw that it lies between 10^4 and 10^5, so that we might imagine its logarithm to lie between 4 and 5, so that it would be 4 + a proper fraction; and that this is the case I shall proceed to show. In fact, 43,284 is $10^{4\cdot 64}$ nearly, so that its logarithm is 4·64 nearly, or $4\frac{16}{25}$ nearly. The reader does not yet understand the meaning of fractional indices; I am now going to explain these as clearly as I can.

I assume the reader to know what is meant by square root and cube root. The square root of a number is another number which on being multiplied by itself produces the first number. Thus 8 is the square root of 64, for $8\times 8=64$. The cube root of a number is another number which on being raised to its third power produces that first number. Thus 5 is the cube root of 125, for $5\times 5\times 5=125$. So the fourth root of a number is that which when raised to its fourth power produces the number; thus 2 is the fourth root of 16, for $2^4=16$. I need not say what is meant by the fifth root, the sixth root, or any higher roots: the reader will see that the order of the root tells us how many times the number must be multiplied by itself in order to produce the number which we already have. Now the square root and the cube root of a number can be found by the employment of processes which are given in all ordinary treatises on arithmetic: if the reader is not acquainted with these methods he need not fear; I shall not assume him to have a knowledge of them. No rules can be given for finding the higher roots directly, except by most fearfully complicated processes, which would be so difficult to remember as to be practically useless.

Now since 3 is the square root of 9 we can express the fact thus: $3^2=9$. Another way, however, is this: $9^{\frac{1}{2}}=3$. So we may say that $25^{\frac{1}{2}}=5$, $27^{\frac{1}{3}}=3$ (for $3^3=27$), $16^{\frac{1}{4}}=2$, $32^{\frac{1}{5}}=2$, and so on to any extent. We may also express it by saying that $\frac{1}{2}$ is the logarithm of 5 to the base 25, $\frac{1}{4}$ the logarithm of 2 to the base 16, and similarly for the others. I shall not, however, here take into consideration bases other than 10.

Suppose we take the product 10×10×10, and find its square root: this may be denoted by $1000^{\frac{1}{2}}$, or by $(10^3)^{\frac{1}{2}}$, or by $10^{\frac{3}{2}}$. Thus the logarithm of the square root of 1000 (which is approximately $31\frac{1}{2}$) is $\frac{3}{2}$, or $1\frac{1}{2}$. So the logarithm of $1000^{\frac{1}{4}}$, or $(10^3)^{\frac{1}{4}}$, or $10^{\frac{3}{4}}$, is $\frac{3}{4}$. Now to find the fourth root we must find the square root of the square root, which in the case of 1000 is finding the square root of $31\frac{1}{2}$ nearly, which will become $5\frac{1}{2}$ nearly. The reader will observe that $31\frac{1}{2}$ lies between 10 and 100, and we have found its logarithm to lie between 1 and 2, and to be very nearly $1\frac{1}{2}$, So we have found that the logarithm of $5\frac{1}{2}$, a number between 0 and 10, is between 0 and 1, and is $\frac{3}{4}$ nearly. In the same way we can imagine that it might be shown that the logarithm of a number between 10,000 and 100,000, such as 43,284, will lie between 4 and 5, and will be nearly equal to $4\frac{16}{25}$, or $4\frac{2}{3}$ nearly, or $\frac{14}{3}$. It expresses the fact that if we multiply 10 by itself till we get the fourteenth power, and then take the cube root of the result, we shall obtain 43,284. This is the explanation which I promised, a short time ago, to make. What I wish to be understood is this:—As the number goes on increasing so does its logarithm: when the number increases from 1 to 10 its logarithm increases from 0 to 1; as the number increases from 10 to 100 its logarithm increases from 1 to 2, and so on.

So much for the theory of the conception of logarithms: I proceed to show their practical application. Let us take two powers of 10, a thousand and a million, say. The logarithm of one thousand to base 10 is of course 3, and the logarithm of one million is 6: I need hardly give the reasons for these statements, that 1000 is 10^3 and 1,000,000 is 10^6. Now what is the logarithm of a million multiplied by a thousand? If the reader multiplies out, and examines the number of 0's in the product, he will find there are nine of them, and the logarithm of the product is therefore 9. But this is the sum of the logarithms of the separate numbers. Now if we try two other numbers, and multiply them together, the logarithm of the product will be found to be the sum of the logarithms of the factors. This is readily seen when both the numbers are exact powers of 10. When either or both are not so, I must ask the reader to take it for granted: I could not explain it without taking a somewhat circuitous route, and even then, perhaps, he might fail clearly to comprehend it. He may leave it for the present.

Now suppose we divide a million by a thousand; of course the quotient is a thousand, of which the logarithm is 3. But this is the difference between 6 and 3, the logarithms of the dividend and the divisor. The reader may try a few more examples of division with exact powers of 10, and he will always find this same result that the logarithm of a quotient is obtained by subtracting the logarithm of the divisor from that of the dividend. Again, the square of a thousand is a million: the logarithm of the one is 3, and of the other 6. The cube of a thousand is a thousand millions: the logarithm of the one is 3, and of the other 9. By such examples as these we see that when a number is raised to any power the logarithm of the number thus obtained is found by multiplying the logarithm of the original number by the index which represents the power. Again, the square root of 10,000 is 100: the logarithm of the one is 4, and of the other 2. By similar examples we see that the logarithm of a root is obtained by dividing the logarithm of the original number by the number representing the order of the root.

Thus, by the aid of logarithms, for multiplication we can substitute addition; for division, subtraction; for raising to powers, multiplication; and for extracting roots, division. I need hardly point out what an immense saving of time and trouble is thus effected. Let us suppose, for example, we have to multiply 2·581926 by 345·7291. We have only to find what are the logarithms of the two numbers, and add them: the result will be the logarithm of the product. We have only then to find what number has this logarithm, and so, of course, get the product.

Now to find the logarithms of most numbers is a task of extreme difficulty,—about as difficult as finding the sine or cosine of an ordinary angle. They are obtained by summing long and complicated series. Fortunately, however, for mankind, they have all been calculated, and are published in books of mathematical tables: I would advise the student, if he takes an interest in the subject, to buy the edition of Mathematical Tables published by Messrs. W. and R. Chambers, of Edinburgh. The price of the book is 3s. 6d., and it contains the logarithms of all numbers from 1 to 100,000, besides tables of sines and cosines and the other trigonometrical ratios, and several other tables. Appended to the book is a preface, containing full directions for using it.

To return to our example:—On consulting the tables we find—

The log. of 2·581926 is 0·4119438
„ 345·7291 is 2·5387359

Sum = 2·9506797

We now look in the tables to find the number whose logarithm is 2·9506797. This is 892·647, which is therefore the product. It will be seen how much shorter and easier is this method than direct multiplication. I might give an example of division, but really the process is the same in every respect, except that, instead of adding the logarithms, we subtract one from the other.

As an example of raising to powers, suppose we require to find the cube of 30·7146. From the tables we find—

Log. 30·7146 = 1·4873449
3

Log. of cube = 4·4620347

and we find, on again consulting the tables, that the number which has this logarithm is 28975·75, and this is therefore the cube. I pity the unfortunate man who has to work out an example such as the above directly. His fate would be most cruel if he had to find a higher power, the seventh for example. But by logarithms it is done without the least trouble.

It will now be perceived that by the aid of logarithms we can find any root we please of a number. Let us find, for example, the 4th root of 76·542:—

Log. of 76·542 = 1·8838998
Its quotient by 4 = 0·4709749

and this is the logarithm of 2·95784, which is therefore the 4th root.

This method is peculiarly useful in the case of the 5th or the 7th, and in fact in the case of most orders of roots, which cannot be found by any direct method.

A NEW BATTERY COUPLE.

By M. J. MORIN.

In a memorandum presented by me to the Academy on the 24th June, 1872, I described a sulphate of copper couple, which I proposed as suitable to therapeutics, and in which the precipitation of the copper was avoided both upon the diaphragm and upon the zinc. I was thus enabled to construct some elements which worked even after two years and a half. Unfortunately the electromotive force was exceedingly small; and though its use might particularly suit one method in the application of therapeutics, it would not be so suitable for another method. In some cases a few of the couples sufficed to furnish the necessary results, since the moderate intensity of the current was compensated for by its prolonged duration: in other instances, on the contrary, a very large number of the elements would be imperative, but required for a few minutes only.

It is with the object of evading the inconvenience attending the use of apparatus so bulky, and at the same time so costly, as evidenced in these latter instances, that I have just constructed a new couple whose electromotive force is much superior to that of the elements employed for therapeutics up to the present date. The couple I refer to has a great analogy to that of Bunsen's, to which it is scarcely inferior with regard to its electromotive force. Unlike Bunsen's element, in which the carbon is plunged into nitric acid, the carbon of this new element is surrounded with a chromic salt whose preparation is due to M. Faucher. This salt, barring the water, very nearly represents the chemical constitution of Jacobi's solution.

An idea of the advantage of this new process may be conveyed by the statement that to produce a determinate effect the above apparatus is reduced to about one-eighth of the size of the sulphate of copper apparatus, and it does not require either maintenance or supervision. It is shut up, and consequently of easy transport. Moreover, one of these elements has been working for several months, and, having regard to its present condition, I hope its duration and constancy will yet last a considerable time.

THE SURVEY FOR THE PACIFIC CABLE.

The work of surveying the bed of the Pacific for a telegraph cable to Japan is making satisfactory progress. A letter in the *New York Tribune*, from a correspondent on the United States steamer *Tuscarora*, gives interesting details of the explorations on the line of a great circle between San Diego, California, and Honolulu, Sandwich Islands. Under date of Honolulu, Feb. 3, he writes:—

"The undertaking now before us will occupy eight or nine months under favourable circumstances. It is as follows:—The determination of the continental outline from the 100 fathoms' line to the ocean bed proper (which is to be considered at 1500 fathoms depth), from San Francisco to San Diego. Then a line of soundings run on a great circle from that place to Honolulu, and thence to to the Bonin Islands, and from there to Yokohama. By that time also the work begun on the great circle route from between Yokohama and Cape Flattery, passing through the Aleutian Islands, will be completed. On the 6th of January we started from San Diego for this place, which we reached yesterday. We encountered only two gales, which occasioned a suspension of work for about five days. Other than this the trip was a most delightful one, and more particularly so from the remarkable and continued success in securing all the important information of which we were in search. The slope of the bed of the ocean to the depth of 1900 fathoms —which was found in lat. 31° 43′ N., long. 119° 28′ W., at 115 miles from San Diego—averaged about 90 feet to a mile. From that position to lat. 23° 10′ N., long. 150° 31′ W., at which point (1750 miles from San Diego) the greatest depth was found, the slope is 3 feet to a mile; while from that position to Honolulu (about 400 miles) the slope is 45 feet to a mile. At a point within about 90 miles from Honolulu, in lat. 21° 43′ N., long. 156° 21′ W., a depth of 3023 fathoms was found. From that point the bottom shoaled rapidly to 498 fathoms in lat. 21° 26′ N., long. 157° 19′, at only 56 miles distance, this slope thus averaging 250 feet to a mile. The greatest elevation in mid-ocean was in lat. 26° 30′ N., long. 127° 37′ W., and was, in fact, the only one worthy of mention. The depth was 2500 feet less than at the succeeding cast, which was taken at 50 miles distance, making the slope 60 feet to a mile. This I mention, however, only as the extreme case, as the *plateau* cannot be regarded otherwise than wonderfully regular. The greatest depth attained was 3053 fathoms (18,318 feet). The average depth of the ocean bed of the Pacific has been theoretically determined, by the researches of the Coast Survey, to be about 2400 fathoms. This we have corroborated practically, considering that portion as the bed which is below 1800 fathoms.

"In this cruise 62 casts were taken at an average of every 38 miles. A yellowish-brown mud or ooze was brought up from the bottom at each cast, and was bottled and preserved for future investigation and analysis. Careful attention has been given to the taking of serial temperatures at all depths. The temperature of the surface water increased gradually from 59° F. off San Diego to 74° F. in the vicinity of the Sandwich Islands. It was generally found that the temperature fell very slowly to about 50° F. at 100 fathoms' depth near the former place, and to 60° F. near the latter, defining distinctly the depth of the equatorial current. A more rapid fall takes place at about 300 fathoms; at that depth, throughout the entire distance, the temperature was nearly constant, standing at about 43° F. Below that there was a steady fall of temperature till the bottom was reached, where the thermometer stood at about 35° F. A difference of 400 or 500 fathoms, more or less, in deep water on this line has no influence upon the bottom temperature. In lat. 26° 22′ N., long. 137° 22′ W., in 2160 fathoms, the bottom temperature was 34° F., the lowest reading obtained. Taking into consideration the Cape Flattery line of soundings, as well as this, the bottom temperature of the Pacific is constant at depths ranging from 1600 to 3054 fathoms.

"But few practical observations of currents were made, owing to the sea being too rough for boat-work; still one, if not the prominent, cause of currents was distinctly demonstrated. Within a few hundred miles of the Sandwich Islands we experienced a long, heavy sea, for two or three days, from the westward, the result of a heavy gale. During this time, notwithstanding we were in the equatorial current which sets to the westward, we were carried by the current in nearly an opposite direction about 4 knots an hour. The wind was light, and from the eastward. Casts are now taken in three miles' depth of water with as little difficulty and as satisfactory results as in shoal,—a fact which is sufficient to demonstrate the perfection of the apparatus used. Over 5000 miles have been traversed, and soundings constantly made with the same length of wire, which is still in good condition. It would be difficult, and, in fact, thus far impossible, to decide which of Commander Belknap's three sounding cylinders was the best adapted to the service required, as the action of each seems perfect.

"It is, perhaps, too soon to discuss now the relative merits of this proposed route, or to attempt to compare it with the Cape Flattery line, the survey of neither being as yet fully made; still, I am forced to believe that sufficient data have been obtained even now to indicate the probable results of future investigations. The strongest—and I think the only—arguments, in favour of the northern route for a telegraphic cable, are the regularity of the plateau and the comparatively light expense, owing to the small amount of cable required, on account of there being less depth and distance between the initial points. In favour of the other route must be considered the local traffic of the South Sea Islands, and especially of Australia, which is now directly in telegraphic communication with Singapore, by way of the Island of Java, and thence westward through the Red and Mediterranean Seas. No difficulty would be experienced in laying a cable over the southern line, since fair winds and good weather almost invariably prevail; and no difficulty would probably occur in dredging for it in case of a break at any time, while at the north the summer months would be the only ones in which such work could be successfully undertaken."—*Journal of the Telegraph.*

Notices of Books.

The Conservation of Energy, being an Elementary Treatise on Energy and its Laws. By BALFOUR STEWART, M.A., LL.D., F.R.S., Professor of Natural History at the Owens College, Manchester. With 14 Illustrations. London: Henry S. King and Co. 1874.

The New Chemistry. By JOSIAH P. COOKE, Erving Professor of Chemistry and Mineralogy in Harvard University. With 31 Illustrations. London: Henry S. King and Co. 1874.

THESE volumes form two of an "International Scientific Series" now in course of publication. On account of the clear and popular style in which a large amount of practical and scientific information is given we confess to a sense of pleasure as we read them. The publishers deserve credit for their selection of authors, and for the "get up" of the volumes themselves; more especially since, in these days of hasty publication, regard is sometimes had rather for the general appearance of the work than for the selection of an author able to write upon science in a style suitable to the general reader.

Professor Balfour Stewart commences with, "What is Energy?" and this question he answers by various illustrations, defining it to be the power of performing work or of overcoming inertia and resistance. The universe may be regarded "in the light of a vast physical machine" whose several parts act and react upon each other without cessation. No part of the material world is in a state of rest, and this implies that matter is bound up by innumerable *energies* or *forces*. In chemistry these forces render themselves visible and become obedient to the chemist's will. In electricity and telegraphy matter yields up its energy under various known forms, such as magnetism, dynamic or static electricity, heat, and attraction or repulsion. We should have been glad if the author had stated what his idea is of the nature or ultimate origin of energy, for, although it cannot be settled definitely, yet we incline to believe that forces of all kinds will be traced to one prime source—that they will yet be classed as species of one genus.

The chief object of this work, as its title proclaims, is that energy is never annihilated, that it never dies, that it conserves for ever, and when expended in one direction reappears in another. For instance, when any substance "is shot vertically upwards we may suppose it to be caught at the summit of its flight and lodged on the top of the house. Here, then, it rests without motion," and, commonly speaking, it is said that the force or energy with which it was propelled upwards has disappeared for ever or been annihilated. Such is not the case. It is true it rests without motion, "but yet not without the power of doing work, and, hence, not without energy. For we know very well that if we let it fall it will strike the ground with as much energy as it had when it was originally projected upwards." It has simply changed from *energy of motion* to one of *position*. All other energies may be similarly traced: that of an electric current shows itself in electrolysis; or in heat when a wire of large resistance completes the circuit; or in magnetism and actual work in a telegraph apparatus. There are many other examples; in fact all nature abounds with them. Growth and decay, life and death, all the changes, visible and invisible, around us are evidences of unceasing transmutation of energy from one form to another; but, however *much* and *constantly* it changes, its conservation is perfect.

Although energy cannot be destroyed, yet it does not follow we can make it reappear to the same extent in its original form. Indeed, were such the case, perpetual motion would be possible. We can with the greatest ease transform mechanical energy into heat, but by no means is it possible to transform all the heat back again into work. Sir William Thomson has given great attention to this problem, and he considers that the mechanical energy of the universe is becoming more and more changed into heat. According to that philosopher, we are led to speculate a time "when the whole universe will be one equally heated inert mass from which everything like life, or motion, or beauty will have utterly gone away." For Sir William's latest published ideas on this subject we refer our readers to his article in "Nature," of April 9, 1874, on the "Kinetic Theory of the Dissipation of Energy."

After reading Professor Balfour's work a student is better able to profitably read the "New Chemistry," based on a series of lectures delivered by Professor Cooke, before the Lowell Institute, Boston, 1872. His aim is to explain the theories of atoms and molecules; the part they play in the modern theories of chemistry; and also to explain the modern chemical theories themselves. A right appreciation of the atomic and molecular theories is essentially necessary, for these theories may strictly be said to have rendered obsolete the chemistry of a few years back. We are not, therefore, surprised that, of 320 pages, 103 are devoted to discussions embracing Avogadro's, Mariotte's, and Charles's laws; the molecular condition of substances; how atoms and molecules are weighed; and their chemical compositions. The author energetically explains his own views respecting the theories he propounds, and says, "Without the atomic theory a large part of the modern science (of chemistry) would be wholly unintelligible. . . . . I must confess that I am rather drawn to that view of Nature which sees in the cosmos besides mind only two essentially distinct beings, namely, matter and energy, which regards all matter as one and all energy as one, and which refers the qualities of substances to the affections of the one substratum modified by the varying play of forces. . . . . . I wish to declare my belief that the atomic theory, beautiful and consistent as it appears, is only a temporary expedient for representing the facts of chemistry to the mind."

We cannot speak in high terms of the electro-chemical theory which Professor Cooke puts forward in explanation of the causes which impel the union of atoms to form molecules. This theory is based on the notion that chemical affinity is a manifestation of polar force closely allied to chemical attraction. This is only an idea, and we do not think the right explanation of it has yet been developed. The author is aware of a defect when he states "as the knowledge of chemical compounds has been enlarged it has been found that whatever may be the resemblances between electrical and chemical attraction, the analogy fails *in the very point* on which the dualistic system relied." We cannot see that a satisfactory substitute has been supplied. Take his example of potassic hydrate. He quotes the existence of a magnet inducing *plus* and *minus* poles in a soft iron core, and says in the $\overset{+}{K}\ \overset{-\ +}{O}\ \overset{-}{H}$ that K is like a magnet with a + pole, that it induces − and + poles in the oxygen atom, attracts it to itself, having the + pole of the oxygen farthest from it, and leaves this + pole of the oxygen at liberty to attract the negative atom H. Our answer to this is, why may not the oxygen atom be considered as the magnet, or H likewise, and so induce opposite poles in K? Again, why is O considered to be naturally of neither polarity when it is known to be very strongly electro-positive, just as H is electro-negative?

Correspondence.

THE SECRECY OF "GOVERNMENT TELEGRAMS" SECURED BY THE USE OF THE AUTOMATIC TELEGRAPH.

To the Editor of the Telegraphic Journal.

Sir,—In reference to the intercepting or taking off messages from telegraph wires, as referred to in the resolution introduced on the 23rd of March last in the House of Representatives at Washington, involving the want of secrecy in the handling of Government telegrams, Mr. Edward Clarke, in his reply to the Hon. James E. Blaine, Speaker of the House of Representatives, very truly says that in some cases the wires connect with instruments in hotels, and that all the wires connect with various cities and stations between Washington and the northern cities.

Permit me to say that the trouble does not end here, and that Mr. J. G. Smith's suggestions, as regards the use of silent Morse instruments in any form, offers no security whatever against the abstraction by unauthorised persons of telegrams from the through wires at way stations, or at any point on a line of telegraph by any ordinary Morse operator as well as by experts, and, therefore, does not, in my opinion, meet the requirements, so far as it relates to the abstraction of Government *or other* despatches.

The only security lies in the use of the "automatic telegraph," for the following reasons:—First, by causing the pulsations of electricity to travel at any rate of speed above that at which a Morse expert is only able to interpret the same either by feel, taste, or by sound. I here refer to the American automatic telegraph, which has been in practical public operation for over two years between Washington and New York. It is an impossibility for the greatest Morse expert to abstract by feel, taste, or by sound, at any point on this line, during automatic transmission of a telegram, as in such attempts it becomes to the party "*ignotum per ignotius.*" And in regard to the office, the *modus operandi* is that of silence; and it matters not how many persons may be in each office during the transmission or reception of a message, by *my* automatic system no one but the copyist need know its purport; and, to meet the copyist's case, Mr. Edward Clark suggested the propriety of passing a law fixing a penalty or punishment on any person who may divulge any message sent by telegraph.—I am, &c.,

Geo. Littte.

Passaic City, New Jersey, U.S., June 9, 1874.

Telegraph Conference.—The principal submarine telegraph companies are now holding a Conference at the offices of the Eastern Telegraph Company, in Broad Street, for the purpose of examining and revising the regulations which were sanctioned by the Telegraph Convention of Rome, with a view of submitting at the next International Conference, to be held at St. Petersburg next year, such alterations as may in their opinion tend to the more effective working of the international telegraph system, and more especially as regards the regulations concerning telegrams exchanged with countries out of Europe. Major Bateman Champain, R.E., represents the Indo-Eurcpean Telegraph Department Sir James Anderson, with whom are Mr. Wells and Mr. Ansell, the Eastern Telegraph Company; Mr. Weaver, the Anglo-American Telegraph Company; Mr. Andrews, the Indo-European Telegraph Company; Colonel Glover, Indian Submarine Telegraphs; Mr. Erichsen, the Great Northern Telegraph Company; Major Wood, the Western and Brazilian Telegraph Company; Mons. Chauvin, the Direct United States Telegraph Company; and Mr. Malcolm J. Brown attends on behalf of the English Telegraph Service.

Electrical Science in English and Foreign Journals.

(In addition to our usual abstracts, there will be found under this heading the titles of papers on electrical science which have appeared in English and foreign journals from the commencement of the present century up to the date of the establishment of this journal).

Vol. XXXII. (1834).

Position of the American Magnetic Pole. P. 224.

On the Cause of Rapid Decrease in the Action of Electric Machines in Moist Air. M. Munck af Rosenschöld. P. 362.

Fifth Series of Experimental Researches on Electricity. Mr. Faraday. P. 401.

Experimental Researches on Electro-Magnetism and Magneto-Electricity. Mr. Ritchie. P. 529.

Vol. XXXIII. (1834).

Sixth and Seventh Series of Experimental Researches on Electricity. Mr. Faraday. Pp. 149, 301, 433, 481.

Observations of the Magnetic Variation in Göttingen and Leipzic on Oct. 1 and 2, 1834. M. Gauss. P. 426.

New Observations on the Electro-Chemical Figures, the Electro-Dynamic Laws, and the Internal Mechanism of the Voltaic Pile. M. Nobili. P. 537.

Vol. XXXIV. (1835).

Observations on the Magnetic Declination in Peking, and its Daily Variations. M. Kowanko. P. 53.

Magnetic Observations from Nertschinsk. P. 58.

On the Magnetism of the Earth. M. Moser. Pp. 63, 271.

Magnetisation through Machine-Electricity. P. 34.

On a Magneto-Electric Apparatus especially useful for Chemical Actions. M. Pohl. P. 185.

Action of Hollow Magnetic Bars. M. Nobili. P. 270.

On the Magneto-Electric Spark and Shock, and on a Particular Condition for Magneto-Electric Induction. Mr. Faraday. P. 292.

On the Laws, according to which the Magnet Acts on a Spiral when suddenly brought near or withdrawn, and on the Best Construction of Spirals for Magnetic Purposes. M. Lenz. P. 418.

On the Conductivity of Metals for Electricity at Different Temperatures. M. Lenz. P. 418.

On the Conductivity of Stiff Bodies for Electricity. M. Munck af Rosenschöld. P. 437.

Experiments to Measure the Velocity of Electricity and Duration of the Electric Light. Mr. Wheatstone. P. 464.

Note on the History of Lightning Conductors. P. 480.

On the Laws of Magnetism, after Ampére's Theory. M. Knochenhauer. P. 481.

On the Point-Armature, an Apparatus well adapted for Production of Magnetic Electric Sparks, and some Experiments with it. M. Böttger. P. 497.

Note on the Magneto-Electric Apparatus. M. Pohl. P. 500.

Observations on Atmospheric Electricity. P. 502.

Report on Recent Magnetic Observations in Göttingen. P. 546.

Vol. XXXV. (1835).

Eighth and Ninth Series of Experimental Researches on Electricity. Mr. Faraday. Pp. 1, 222, 413.

Discovery of a Substance, which, in Contact with other Electromotors, Produces a much Stronger Negative Electricity than any hitherto met with. M. Munck af Rosenschöld. P. 46.

Observations on the Daily Variations of the Declination at Archangelsk. M. Reinike. P. 58.

Remarks on a Paper by M. Munck on Thermo-Electricity of Glass. M. Lenz. P. 72.

On a New Experiment in Magnetisation. M. Aimé. P. 206.

On the Remanent Magnetism of Soft Iron. Mr. Watkins. P. 208.

On the Discontinuity of the Flash of Lightning. M. Dove. P. 379.

Observations of the Magnetic Variation on April 1, 1835, at Five Places. M. Gauss. P. 480.

Report on a Remarkable Stroke of Lightning. M. Naumann. P. 519.

Vol. XXXVI. (1835).

On the Prismatic Decomposition of the Electric Light. Mr. Wheatstone. P. 148.

On Distribution and Combination of Electricity in Insulated Conductors. M. Mohr. P. 321.

The Lightning Wheel, an Apparatus for Quickly Alternating Galvanic Closures and Breaks. M. Neef. P. 352.

Jacobi's Commutator. P. 365.

On the Action of Voltaic Electricity on Alcohol, Ether, and Aqueous Solutions. Mr. Connell. P. 487.

Tenth Series of Experimental Researches on Electricity. Mr. Faraday. P. 505.

Description of Two New Thermo-Electric Piles, and their Use in Researches on Heat. M. Nobili. P. 525.

On a Method of Obtaining Strong Horse-Shoe Magnets by Stroking. M. Mohr. P. 542.

Simple Apparatuses for Explanation of Electro-Dynamic Phenomena. M. Pinaud. P. 548.

Poggendorff's Annalen der Physik und Chemie.

No. 3, 1874.

On the Conductivity of Mercury Vapour for Galvanic Currents.—M. Herwig.—Reserved for separate note.

On the Galvanic Conductivity of Sulphuric Acid and Muriatic Acid, and its Dependence on Temperature.—M. Grotian.—These experiments were made with the induction currents from a rotating magnet, and with a bridge combination. The conductivity of sulphuric acid is expressed by the formula $L=L_0(1+\alpha t+\beta t^2)$, where t denotes the temperature, L_0, α, and β constant coefficients. For muriatic acid the formula is $L=L_0(1+\alpha t)$. The displacement of the maximum, for sulphuric acid, is approximately proportional to the temperature. The maximum occurs at a higher percentage proportion (of acid) the higher the temperature. Muriatic acid shows a less displacement, and curiously, in the opposite direction, the coefficients of increase α diminish with increasing concentration. M. Grotian finds the maximum of conductivity of sulphuric acid at 22° to occur with a percentage of 30·88, this being 0·68 less than that found by Kohlrausch and Nippoldt. He gives curves showing the dependence of conductivity on temperature. There is a close similarity up to 50° between those for sulphuric acid and those given by Beetz for sulphate of zinc. The curves for the lower concentrations present their concave side to the axis of co-ordinates (temperatures), while, for stronger concentrations, they present a convex side.

Researches on Galvanic Polarisation and Distribution of the Current in Electrolytes.—M. F. Müller (Concluded). Reserved for separate note.

Experimental Determination of the Di-Electricity Constants of Insulators.—M. L. Boltzmann.—See below.

No. 4.

Theory of Influence-Machines.—M. Veltmann.—To obtain a sure basis for theory, the author thought it desirable to study a machine in which, while the principle of Holtz is retained, the rotating disc is replaced by another apparatus which, of the two resistances, in axial and peripheric direction, possesses only the latter. Such a machine he describes.

Experimental Determination of the Di-Electricity Constants of Insulators (Concluded).—M. L. Boltzman.—The greater accuracy obtainable with new instruments led the author to this investigation. The capacity of an ordinary Kohlrausch condenser with two vertical plates was measured for varying distances of the plates. Then layers of different thickness of insulating substance were put between the plates, and its capacity was again determined. According to the Maxwell-Helmholtz theory, the capacity of the condenser (excluding the electricity at the edge of the plate) simply depends on the distance, m, of the plates and the thickness, n, of the di-electric layer, but not on the position of this between the plates. If D be the di-electric constant of the layer it is inversely proportional to the expression $m-n+\frac{n}{D}$; and so to the distance of the plates. This was fully confirmed. The author used Thomson's electrometer, and in one series of experiments substituted a mercury-condenser for that of Kohlrausch. The following values of di-electric constants were obtained:—Hard gum, 3·15; paraffin, 2·32; sulphur, 3·84; colophony, 2·55. These numbers differ widely from those of previous observers, being higher. M. Boltzmann thinks the difference cannot have arisen from accidental difference of material or temperature of observation; and that (apart from less fine measurement) some of the previous observers may have assumed the space between the condenser plates to be entirely filled with the insulating substance, which can never be fully realised in experiment. The plates, too, might be forced slightly further apart where the interval is filled too densely. Both circumstances would make the values too small. The author's results confirm Maxwell's theory, according to which, if electricity and light are vibrations of one and the same medium, the quotient of refraction must be the geometric mean between the coefficient of di-electricity and that of magnetisation.

On the Electromotive force of Palladium in Gas Batteries.—Prof. Vallari.—Reserved for separate note.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, Vol. lxxviii., No. 23. June 8, 1874.

Modification Introduced to the Commutator of Clarke's Machine.—By M. A. Barthélemy.

No. 24. June 15, 1874.

Researches on the Electrolysis of the Carbonate and Bicarbonate Alkalies.—By MM. P. A. Favre and F. Roche.—A chemical exposition of great length.

The Phenomena of Static Induction Produced by Means of Rhumkorff's Coil.—By M. E. Bichat.—Will appear in full in a later issue.

On Magnetism.—By M. J. M. Gaugain.—(paragraphs 70 to 73). When the distribution of magnetism is determined by the method of "*weights carried*" it is found that friction applied from the heel to the poles diminishes the polarity in the neighbourhood of the heel, and increases it towards the poles; whilst friction in an opposite direction produces opposite results. That being the case, confining ourselves to the consideration of the phenomena of attraction, we may, according to M. Jamin's views, liken magnetism to a *heap of sand changeable in figure though the mass remain invariable*, and say that friction exercised at the middle of a soft bar of iron sweeps the magnetism now towards the heel and now toward the poles. The author does not see how this conception will apply to the phenomena of induction described in one of his late notes. Taking the depolarising current as measure of the magnetism, it is found that friction from the poles to the heel diminishes the magnetism throughout, whilst inverse actions increase it everywhere. Now if we place ourselves at the point of view adopted by the author the phenomena of attraction dovetails very simply with the phenomena of induction. Indeed, after what was said in 1873, the magnetic attraction depends not on the height of the demagnetising curve (then described), but upon its inclination. See Telegraphic Journal, vol. i., page 226.

No. 25. June 22, 1874.

On the Use of Phenic Acid for the Preparation of Woods.—By MM. Boucherie.—It is admitted that if tar increases the durability of woods exposed to air and moisture, this property is owing to its phenic acid and its creosote. It is, then, rational to believe that in replacing the sap of the trees with slightly phenic water they are protected from rot. To test it I impregnated, in the month of August, 1868, some woods with solutions of phenic acid; ½, 1, and 2 in 100 parts. These woods placed in ground of rich mould were withdrawn in May, 1874, with a result far from good. I have not used the phenic acid above 2 in 100 parts on account of its insolubility in water. Probably if the wood were impregnated with a solution of 8 to 10 parts for every 100 we should obtain satisfactory results: but how can it be done? The dissolvents of phenic acid are all very costly, and consequently useless for practice. Besides, this acid does not exercise any appreciable action on the tissue of the wood; it simply acts on the albumenoid matters which the vessels enclose, whilst sulphate of copper combines so well with the cellulin that washing with pure water will never expel it. Phenic acid, on the contrary, is insensibly driven from the wood under the influence of water. M. Boucherie considers that phenic acid can only be rendered useful by mixture with sulphate of copper to defend stakes driven into the sea against the attacks of the teredo.

Le Mondes. Vol. xxxiv., No. 7. June 18, 1874.

Thermo-Electric Battery.—By M. Clamond.

Electric Telegraphy in Hotels.—An ingenious arrangement proposed by M. Debayeux, to simplify the transmission of orders in a hotel.

We hope to return to these subjects at a later date.

No. 8. June 25, 1874.

Devoid of papers on electrical or telegraphic subjects.

Boston Journal of Chemistry. June, 1874.

Static Electricity as a Therapeutical Agent.—Although frictional or static electricity, in a primitive form, was employed fifty years ago in the treatment of disease, it has been quite superseded in our day by galvanic electricity. Dr. Arthius, of Paris, has recently devised new methods for the application of static electricity, and claims that as a therapeutical agent it has many advantages over the other form of the force. He has published a little book on the "Treatment of Nervous and Rheumatic Affections by Static Electricity," in which he describes his apparatus and process, with an account of cases in which cures have been effected by their use.

Van Nostrand's Eclectic Engineering Magazine. July, 1874.

Contains nothing suitable for "The Telegraphic Journal."

The American Journal of Science and Arts. May, 1874.

On a Method of Freeing a Magnetic Bar from the Influence of the Earth's Magnetism.—John Trowbridge.—Referring to Dr. J. P. Joule's method of freeing magnets from the inductive action of the earth's magnetism, which is given at length in "Clerk Maxwell's Electricity and Magnetism" (vol. ii., p. 105), the author states that it is desirable in many investigations on magnetism to free a needle not only from the inductive action of the earth, but also from its directive influence. The method Mr. Trowbridge adopts is the following:—An ordinary tangent galvanometer is so constructed that the coil is free to turn about a vertical axis, and also about a horizontal one. The coil is first placed in a plane perpendicular to the magnetic meridian; it is then turned about its horizontal axis until the component of the strength of the current acting in the horizontal plane shall be just equal and opposite to the horizontal component of the earth's magnetism. If we denote by θ the angle which the plane of the coil makes with a vertical plane, and by *a b* the strength, S, of the current passing through the coil of the galvanometer, we shall have $S \cos \theta = \mu$, in which μ is the counter-balanced force of the earth's magnetism. Under these conditions the magnetic needle is evidently in a state of nnstable equilibrium, and, if placed perpendicularly to the magnetic meridian, will vibrate through small arcs free from the influence of the earth, and subject only to the attraction in the field of force in which it may be placed. A bar of soft iron placed in the vertical plane which passes through the suspension of the needle perpendicular to he magnetic meridian, at a suitable distance from one of the poles of the needle, serves to bring it back to zero, just as the controlling magnet serves a similar purpose in Thomson's reflecting galvanometer. *This method constitutes practically a new astatic system.*

A Spark Adjuster for the Holtz Machine.—J. J. Minot.—The author quotes the following method for obtaining different kinds of electric sparks from the Holtz machine:—Having insulated the outer coating of the two Leyden jars of the machine, connect short thick wires from them to two brass pointers or conductors, so arranged that the distance between them may be varied at pleasure. With this arrangement the following results were noted:—At first the conductors were placed in connection with each other, when it was found that a series of sparks were given off between the conductors of the machine: the sparks had for extreme length 20 c.m. They were large and luminous, passed only at intervals, and required a certain electric tension. The pointers connected with the outer coating of the Leyden jars were then drawn apart to 13 m.m., when a succession of fine thread-like sparks passed across the space separating the conductors of the machine, whereas there was no such appearance between the pointers connected with the jars. But at intervals a larger spark, not so bright as the normal spark of the machine, would jump across the conductors, and simultaneously with this a similar spark passed between the pointers. This fine line of sparks was found to have a peculiar form, being brightest and largest at the ends of the conductors of the machine, fading away to a lighter and redder tint, and being of a thread-like character in the space between the knobs of the conductors. It was found, if the distance between the conductor of the machine exceeded a little that between the pointers connected with the Leyden jars, that no large sparks passed between either set of conductors, but only a series of thread-like discharges; when less a similar result was obtained. When the pointers were but a few millimetres apart a continuous hoop-like discharge passed between them, which was not interrupted by the occasional passing of a bright spark, and was not coincident in path with the latter. By varying the distance of the pointers of the Leyden jars, the number and character of the sparks could be changed at will.

Effect of Condensers on the Brush Discharge from the Holtz Machine.—J. W. Fewkes.—The readiest way of producing the brush discharge is to connect the negative conductor of the Holtz machine with the ground, and to place the hand in its neighbourhood with one finger extended toward the positive conductor; the brush then makes its appearance on the positive conductor. Faraday, in his "Experimental Researches in Electricity" (vol. i., p. 454), has fully described this peculiar electric discharge. Since his epoch the use of condensers in connection with electric machines has so altered their range that the following experiments were instituted to observe the effect of such condensers on the brush discharge. *Experiment* 1.—If both condensers were removed from the machine, and the negative pole connected with the ground, the brush made its appearance on the knob of the positive conductor. *Exp.* 2.—A plate of vulcanite, held in the hand, was interposed between the conductors, and produced the same effect as the hand alone: if, however, the vulcanite were supported on an insulated stand, no brush appeared: a metallic disc held in the hand failed to produce the brush. *Exp.* 3.—A condenser was connected with the positive pole, the other connection remaining as before: the brush made its appearance, but was less stable, and consisted of a uniform straight spark of 25 m.m., terminating in interweaving rays: there was a continual tendency to break into the ordinary electric spark, due, doubtless, to the increase of electric density resulting from the use of the condenser. *Exp.* 4.—For the condenser of the machine a larger one, from five to six times its capacity, was substituted: the brush disappeared. *Exp.* 5.—A pointed metallic wire was held in the hand, and directed toward the brush: it immediately disappeared. *Conclusions deduced.*—The use of condensers of large surface is prejudicial to the continuance of the brush discharge. This phenomenon, evidently resulting from the tendency of the electric state on the positive conductor to combine with the state which it induces on a neighbouring large and poor conductor, is best produced by a continuous supply of a positive charge, small comparatively in quality, which is continually dissipated by the inductive action of the large body in the neighbourhood. Condensers of a smaller extent of surface than those in common use on the Holtz machine appear better adapted to produce a continuous discharge.

Scientific American. Vol. xxx. No. 24.
June 13, 1874.

M. Alvergnat has devised an ingenious apparatus which shows that an electric current will not pass equally well in two directions. Two glass tubes are connected together at the ends by arched pieces, and in one the points of a number of small glass pipes are turned in the opposite direction from those in the other tube. The current instantly passes through the tube in which the points are apex toward the negative poles. The tubes are filled with hydrogen, showing the oscillation of the luminous zones with great clearness.

Journal of the Telegraph. Vol. vii. No. 11.
June 1, 1874.

The Telegraph in Japan.—The rapid progress which the Japanese are making is very forcibly shown in their telegraphic extensions. Mr. T. J. Larkin, who has been in that country for the last three years—having gone out there from England under an engagement with the Japanese Government—is the Superintendent of the Telegraphs. The metropolis, Tokia, is fully connected by telegraph to all the principal points, twelve stations having been opened in that city. The whole system is constructed on Siemens's iron poles. The lines have been extended about 200 miles to the north, with a railway system in process of construction. The instruments principally used upon the Japanese lines are Siemens's Morse, worked by the polarised relay, Hawley's Morse, Brequet's dial instruments, and, for railway purposes, Siemens's needle instruments and blocks. Porcelain insulators are used, and made in the country, as also galvanised iron for the wires. The work of construction is being pushed north of Yokohama to Hokodadi. The Japanese operators are becoming quite expert manipulators, and bid fair to prove, in the future, good telegraphers. All of them understand more or less of the English language.

June 15, 1874.

A Theory of the Source of Terrestrial Magnetism.—Prof. Challis.—This theory attributes magnetic streams to impulses given to the ether by the earth's atoms in motion. The author first seeks to show that the earth's motion of translation can have little or no magnetic effect. Then, as to rotation, the theory is, briefly, as follows:—While there is any relative *circular* mrtion between the ether and the atoms the latter will continually impel the ether till the relative motion is reduced to zero. Ultimately, therefore, the circular motion of the ether, within the earth, is the same as that of the atoms by which it is impressed. By reason of centrifugal force the circular motion will produce in the external ether an amount of circular motion decreasing with distance from the axis of revolution. Now, the earth's rotatory motion will tend to draw th ether from the axis equally in all directions in any given transverse plane; and the external ether will rush in at the pole parts to supply any vacancy arising from centrifugal force. If the solid and fluid parts of the earth were symmetrical with respect to the equatorial plane, these tendencies would just counteract each other, the influx at each pole would be stopped, and no currents other than the circular would be generated. But, the case being otherwise, there is a differential action, whereby streams are produced, which, as circulating, are permanent relatively to the earth. The currents being always towards the positions of greatest atom-density, they will flow out of the northern parts (in which land preponderates), and, after circulating, enter into the southern parts. And it is in accordance with the theory that in the Northern Hemisphere there are two positions of maximum intensity; one in a high latitude of the North American continent, the other a little north of the Asiatic. There is not the same reason for two maxima in the Southern Hemisphere; and, in fact, observation shows that, if there be two, they cannot be far apart. Hence, too, the theory accounts for the circumstance that the magnetic intensity is greatest near the South Pole; for the total influx is necessarily equal to the total efflux; and the influx is intensified in that quarter, either because there is but one position of maximum intensity, or, if there be two, because they are near each other. The author finds further support for this theory in certain phenomena of aberration, as showing the reality of an impulsive action between atoms and ether.

It is stated that the Cuba Submarine Telegraph Company have just concluded a contract with Hooper's Telegraph Works Company for the duplication of two-thirds of their existing system of cable, viz., the section from Cienfuegas to Santiago de Cuba, the necessary capital having been promptly subscribed by the shareholders. In dealing with the contractors upon a strictly cash basis, the result is that the company obtains an equally good cable at half the price paid for their former one; and at one-half, and even one-third, the price recently paid by other companies for similar cables.

The number of messages passing over the Cuba Submarine Telegraph Company's line during the month of June amounted to 1749, estimated to produce £2000, against 980 messages, producing £1017 in June last year.

Patents.

NOTICES TO PROCEED.

1026. C. V. Walker, of Surrey, telegraph engineer, in respect of the invention of "An electrical train describer for indicating on a distant dial the names of trains, applicable also for other purposes."—*Dated March* 24, 1874.

1779. L. Finger, of Boston, U.S., in respect of the invention of "Improvements in electro-magnetic annunciators."—*Dated May* 19, 1874.

GRANTS FOR PROVISIONAL PROTECTION FOR SIX MONTHS.

1493. To William Baker and John Unwin, both of Sheffield, in the county of York, for the invention of "Improvements in the preparation and in the electro-deposition of nickel upon metals."

1684. To William Augustus Camp, of the city and state of New York, United States of America, now of 8, Southampton Buildings, London, for the invention of "Improvements in telegraphic signalling apparatus."

1820. E. O. W. Whitehouse, of Middlesex, for the invention of "Improvements in producing electric light."—*Dated May*, 1874.

1855. G. Zanni, of Middlesex, gentlemen, for the invention of "Improvements in submarine and other telegraphic cables."—*Dated May* 27, 1874.

PATENTS WHICH HAVE BECOME VOID.

1307. Léon Delperdange, of Schaerbeck, near Brussels, in the kingdom of Belgium, manufacturer, for an invention of "An improved method of and apparatus for laying and protecting underground telegraph wires."—*Dated May* 4, 1867.

1308. John Henry Johnson, of 47, Lincoln's Inn Fields, in the county of Middlesex, gentleman, for an invention of "Improvements in magneto-electric signal lights, and in apparatus connected therewith."—A communication to him from abroad by Auguste Berlioz, magneto-electric machine maker, of Paris, in the empire of France.—*Dated May* 4, 1867.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

3736. W. Darlow and H. Fairfax, both of Middlesex. *Improvements in magneto appliances and in magneto-electric apparatus for curative and other purposes.* Dated November 18, 1873.—This invention relates first to the protection and insulation of portable magnets coated with a thin non-conducting waterproof case or covering, which has been rendered waterproof by varnish or otherwise, or by covering the magnets with tin, lead, or other foil. Also in placing the insulating material so as to overlap, and insulating the two poles of the magnet, and the centre portion by covering with sealing-wax or other suitable material.

3780. W. Hooper, of London. *Improvements in the manufacture of telegraph cables, and in covering telegraphic conductors.* Dated November 20, 1873.—This provisional specification describes the use in telegraph cables, and to cover telegraph conductors of the soft pitch of cotton-seed oil, or it may be the oil "foots" oxidised by means of nitric acid together with hard pitch from the same source. The soft pitch is also employed to saturate the fibrous yarns of telegraph cables.

3823. G. A. Poole, of York. *A new or improved means of and apparatus for indicating the depth of water under vessels afloat, partly by mechanical means and partly by electricity.* Dated November 22, 1873.—The novelty consists in the application of electricity for this purpose, and in indicating by hand and dial the depth of water under vessels.

3862. M. Gray, of Kent, engineer. *An improved mode of maintaining the insulation of underground telegraphic wires.* Dated November 26, 1873.—The object of this invention is to maintain the insulation of wires covered with gutta-percha or equivalent insulating materials, and used as underground telegraphic wires. This is effected by enclosing such wires in cast-iron or other pipes which are filled with water, and which may be divided longitudinally or not. The pipes are connected together by flanged or other water-tight joints.

3943. E. Verdeau, of Bordeaux, France. *A new electric pile to be used in telegraphy, locomotion, and electrical lighting.* Dated December 2, 1873.—This invention consists in the use of a worm made of iron instead of zinc and of hydrochloric acid. Azotic acid may, however, also be used in conjunction with the iron worm. The advantage claimed for this invention is very great economy as compared with other piles.

UNITED STATES.

150,513. J. Beamer and W. A. Jackson, Detroit, Mich. *Telegraphic Fire Alarm Box.* Dated November 3, 1873.—Studs on endless band vibrate key lever for giving signals. In fire alarm telegraph signal boxes a detachable endless chain with groups of studs in combination with wheels.

150,553. L. Finger, Boston, Mass. *Electro-magnetic hotel register.* Dated April 3, 1874.

150,566. J. H. Guest, Brooklyn, N.Y. *Thermostat and thermostatic alarm.* Dated March 14, 1874.—Thermostat bar or tube of one material, acting by lineal instead of differential expansion. Uses rubber for such bar.

150,847. T. A. Edison, Newark, N.J., and G. Harrington, Washington, D.C. *Receiving instrument for chemical telegraphs.* Dated July 29, 1873.—A stylus for a chemical receiving instrument, in combination with mechanism for communicating to such stylus a rapid vibration toward and from the paper for the purposes set forth.

150,848. T. A. Edison, Newark, N.J., and G. Harrington, Washington, D.C. *Chemical or automatic telegraph.* Dated January 15, 1874.—Uses an induction coil as a relay or repeater at intermediate points, the induced current taking place of fresh battery current. A circuit for chemical telegraphs composed of the primary circuit operated by the transmitting instrument, and an induction relay coil to act in the receiving instrument by a secondary circuit, substantially as set forth.

THE Great Northern Telegraph Company's traffic receipts for the month of June amounted to 391,913 francs, against 265,753 francs last year; and the total receipts from January 1 to June 30 were 2,089,408 francs, against 1,450,239 francs last year.

To Correspondents.

⁂ Duly authenticated contributions, theoretical and practical, on every subject identified with the interests of which "THE TELEGRAPHIC JOURNAL" is the organ, will always command attention. Anonymous correspondence will be wholly disregarded. Literary communications and books for review should be addressed to the EDITOR; business communications to the PUBLISHER.

SUBSCRIPTIONS.

Copies of the journal may be obtained through newspaper agents in every part of the world. Should any difficulty arise in procuring copies, direct communication with the PUBLISHER is requested.

Gentlemen desiring to subscribe and receive this paper regularly, are requested to send a remittance to the Office at Boy Court, Ludgate Hill, London, E.C., for 9s., if residing in the United Kiugdom; if in Africa, Australia, Belgium, Brazil, Canada, Egypt, France, Gibraltar, Jamaica, Malta, Mexico, Monte Video, Natal, New Zealand, Sweden, United States, West Indies—10s.; if in Austria, Ceylon, China, Holland, India, Italy, Japan, Portugal, Germany, South America (West Coast), Spain, Switzerland, Turkey, Valparaiso—12s.; if in Russia, 14s.

Cheques and Post Office Orders to be made payable to HENRY GILLMAN, and to be crossed "London and County Bank."

ALL SUBSCRIPTIONS PAYABLE IN ADVANCE.